Chapter 2

Overview of stormwater in Australia

2.1 Stormwater is rainwater that runs off impervious or saturated surfaces in the urban environment, such as roofs, roads and pavements, and green spaces. In an undeveloped environment, natural vegetation and pervious areas allow for rainwater to infiltrate soils, allowing for transpiration by vegetation and evaporation into the atmosphere.[1] Urban development replaces large areas of vegetated ground with impervious surfaces, such as roofing and paving. Accordingly, the volume of stormwater runoff increases with urban development. Dealing with stormwater is essential for flood mitigation, which has shaped how stormwater has typically been managed.

2.2 Two broad issues are evident from the evidence received by the committee, namely that:

- stormwater is considered to be an under-utilised resource in Australia; and
- pollutants in urban stormwater runoff are a significant contributor to the degradation of urban waterways, and utilisation or better management of stormwater could reduce this damage.

2.3 This chapter outlines background information about stormwater in Australia, including the volume of stormwater, pollutants in urban stormwater and how stormwater is currently managed. The chapter then considers some of the benefits that stakeholders consider could be realised if stormwater is utilised to a greater extent.

Quantity of stormwater runoff

2.4 There is no clear record of stormwater volumes.[2] One estimate put to the committee is that Australia's urban areas produce around 3000 gigalitres of average annual runoff.[3] Another estimate put forward is that 'at least two-thirds' of the current urban stormwater runoff 'is in excess of what would have naturally occurred prior to settlement'.[4] A further estimate suggested that urbanised environments lead to a 90 per cent increase in the volume of water entering streams.[5]

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1 eWater, *Submission 9*, p. 3.

2 Australian Water Association, *Submission 47*, p. 1.

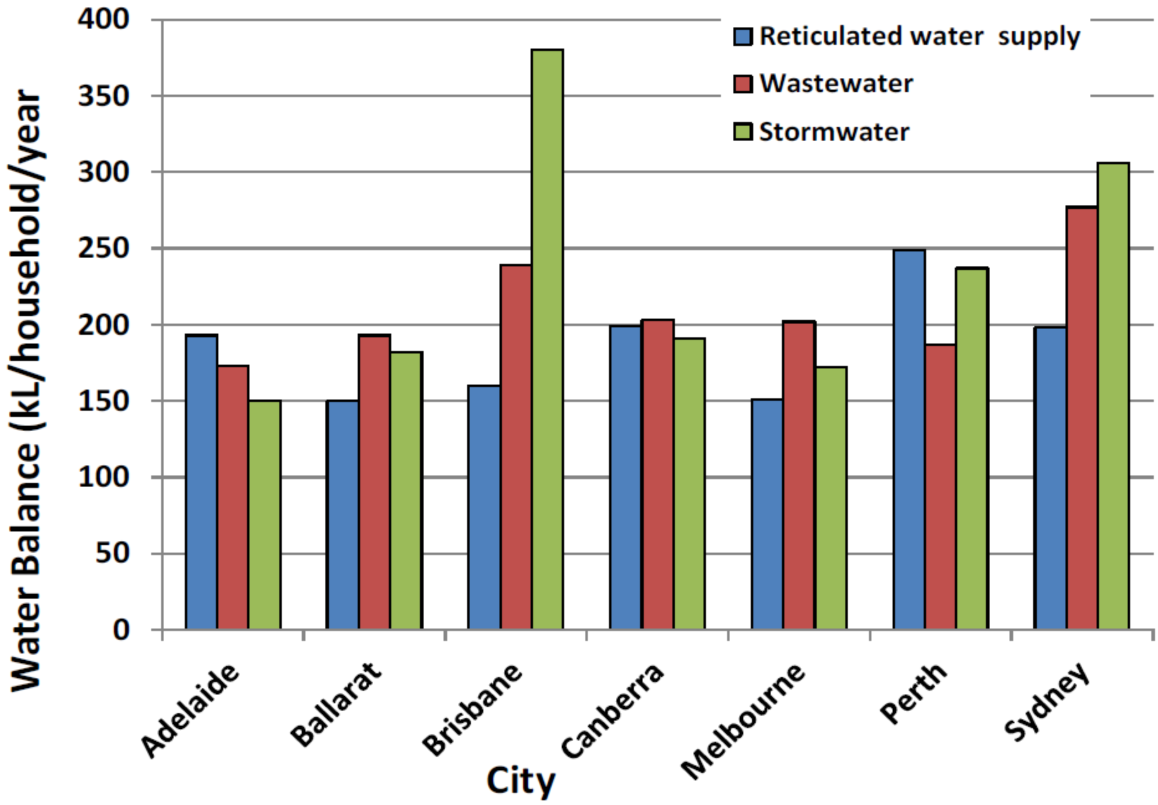
3 Stormwater Australia, *Submission 19*, p. 3. This figure includes all rainfall falling on urban areas (that is, both rainwater and stormwater).

4 Stormwater Australia, *Submission 19*, pp. 3, 8.

5 Mr Chris Beardshaw, Secretary, Stormwater Victoria, *Committee Hansard*, 18 May 2015, p. 11.

2.5 The runoff in Australian cities generally exceeds the volume of water that the cities draw from their catchments and groundwater sources, which is estimated to total 2100 gigalitres.[6] Figure 2.1 indicates how, for selected cities, the average annual volume of stormwater per household is similar to, and in some cases exceeds, the volume of other types of water used in the city.

Figure 2.1: Average annual water balances from households, various cities



Source: Urban Water Cycle Solutions, *Submission 41*, p. 5.

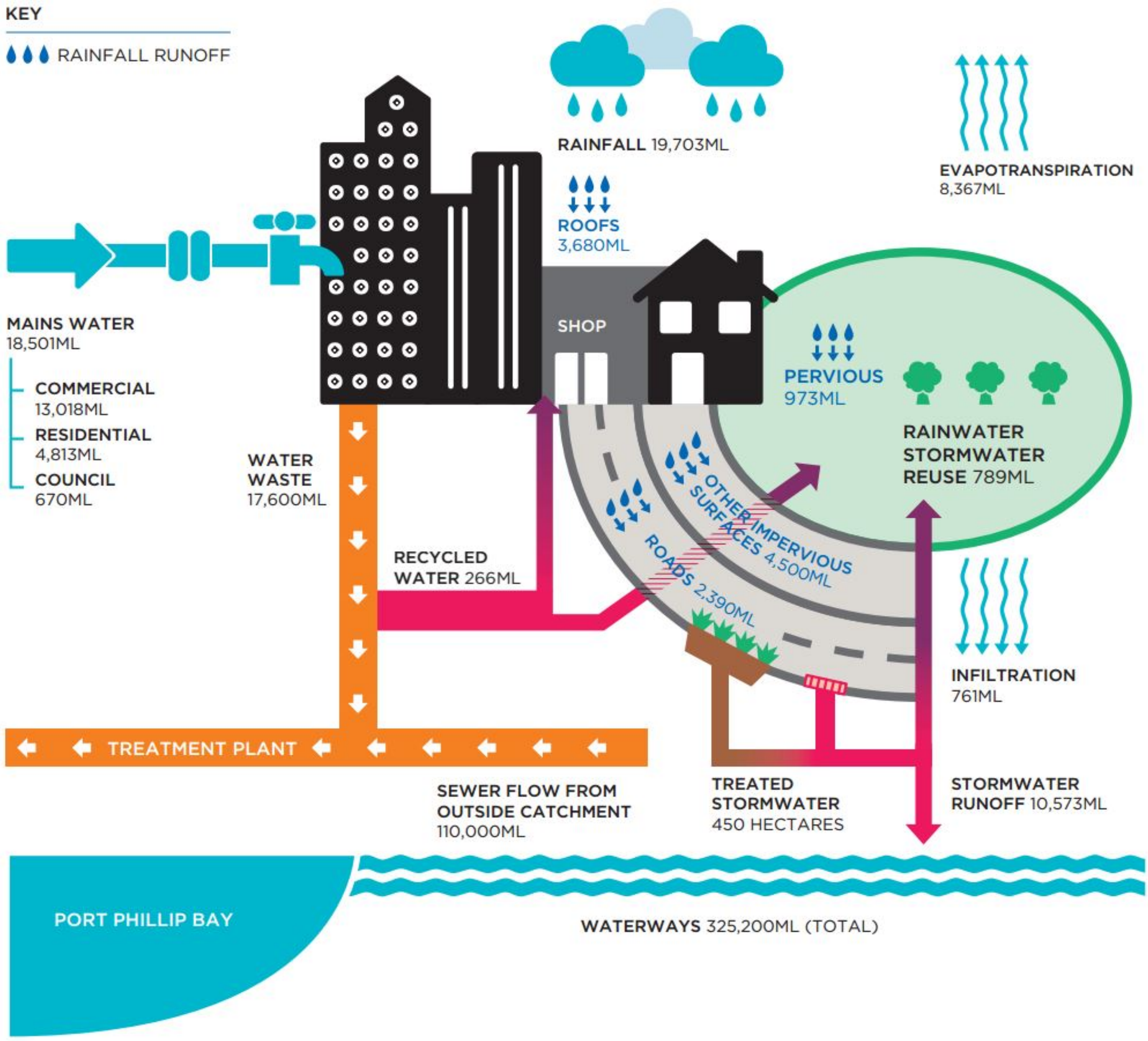
2.6 Using Melbourne as an example, Figure 2.2 illustrates the water cycle of a major Australian city, indicating the overall volume of stormwater received and the quantities of stormwater that are either utilised in the city or discharged as runoff.

2.7 Future growth in Australia's urban centres and more frequent extreme weather events due to climate change may increase volumes of stormwater further.[7]

6 Stormwater Australia, *Submission 19*, p. 3.

7 Stormwater Australia, *Submission 19*, pp. 6, 8 and 9; CSIRO, *Submission 42*, p. 2; Cooperative Research Centre (CRC) for Water Sensitive Cities, *Submission 44*, p. 1. However, the Eastern Metropolitan Regional Council noted that since the early 1970s, rainfall in the Perth region has been in decline, a trend that is expected to continue. The Council stated: 'Perth has not received the rainfall the Eastern States have and the rhetoric around the drought ending does not apply to the Perth region'. Eastern Metropolitan Regional Council, *Submission 26*, p. 2.

Figure 2.2: Melbourne's water cycle



Source: City of Melbourne, 'Total Watermark—City as a Catchment: Update 2014', *Tabled Document 4*, p. 13.

Environmental implications of stormwater

2.8 The committee received evidence on how stormwater transfers pollutants from the urban environment into local waterways, rivers and bays. For example, the University of Melbourne's Waterway Ecosystem Research Group submitted that stormwater 'is the primary driver of the degradation of streams, estuaries and embayments in Australia's cities, and indeed in cities around the world'.[8] This section outlines the types of pollutants that stormwater can contain and the damage runoff causes to the health of waterways.

Overview of pollutants

2.9 Stormwater can carry various pollutants including litter; soil; organic matter; grease, oil and metals collected from roads and properties; and fertilisers from gardens.[9]

2.10 The Adelaide and Mount Lofty Ranges Natural Resources Management Board provided an insight into the amounts of heavy metal pollutants (including copper, lead and zinc) stormwater transfers from metropolitan Adelaide to Gulf St Vincent. The Board referred to research that yielded the following findings:

> Mean and median total concentrations of copper, lead and zinc in most stormwater exceed the guidelines for marine species protection… Concentrations are highest in stormwater from highly urbanised catchments in the central metropolitan area. Median copper and lead concentrations are between 2 and 10 times, and 1.5 and 4 times the guideline values respectively. Median zinc concentrations also exceed the guideline values.[10]

2.11 IECA Australasia submitted that numerous studies have shown that construction sites are the largest contributor to pollution in stormwater. It advised that construction sites produce 50 to 200 times the amount of sediment and particulate pollution produced by completed urban areas.[11]

2.12 As stormwater can transport litter, the contribution of stormwater to marine pollution was also noted. SPEL Environmental submitted that 'because most litter makes it way to the worlds shared oceans and distant coastlines from land based stormdrains, litter solutions begin locally'. SPEL Environment noted that Victorian cities have installed 'more than 4000 side entry and in line litter traps, and in one year captured 2700 metric tonnes of litter from the stormdrains'.[12]

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8 Waterway Ecosystem Research Group, The University of Melbourne, *Submission 17*, p. 2;

9 Australian Water Association, *Submission 47*, p. 1. Australian Government, 'Your Home: Stormwater', www.yourhome.gov.au/water/stormwater (accessed 9 September 2015).

10 Adelaide and Mount Lofty Ranges Natural Resources Management Board, *Submission 11*, p. 1.

11 IECA Australasia, *Submission 2*, p. 1.

12 SPEL Environmental, *Submission 12*, p. 2.

Implications for ecosystems and waterway health

2.13 Stormwater can have significant environmental consequences for the waterways that receive it. Professor Timothy Fletcher, a professor of urban ecohydrology at the University of Melbourne, provided the following assessment of the health of Australia's urban waterways:

> Our urban rivers and creeks are greatly polluted and they require a great deal of investment to deal with erosion. As a result, they do not deliver any of the ecosystem services that a healthy stream might deliver—water purification, mitigation of flooding and, very importantly, protection of downstream waterways such as beaches and bays. Instead, our urban streams actually become a health hazard every time it rains.[13]

2.14 Professor Fletcher stated that the 'primary cause of this degradation is urban stormwater run-off'. He explained:

> We only need a very small proportion of a stream's catchment to be urbanised and to be draining that impervious run-off into the stream via pipes to end up with a highly degraded stream. So it really happens quite quickly.[14]

2.15 Professor Tony Wong from the Cooperative Research Centre (CRC) for Water Sensitive Cities offered similar comments about the effect that stormwater has on urban waterways:

> We…know from research and evidence presented by others that stormwater run-off has a significant impact on stream ecosystem health. Altered flow regimes and poor water quality as a result of stormwater run-off from impervious surfaces can render our restoration efforts for urban waterways largely ineffective. In fact, many cities have given that up and simply used concrete lining of our waterways to overcome the impact of stormwater on our urban waterways. The outcome of that, of course, is the significant degradation of the quality of our urban environment and the quality of the ecological health of our urban waterways.[15]

2.16 Or as Mr Andrew Allan from Stormwater Australia put it:

> Essentially, with most of the urban streams in [the] inner-city, once you have more than five or 10 per cent of the city drains collected through the pipes the ecological value of the waterways is essentially stuffed and that is

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13 Professor Timothy Fletcher, Professor of Urban Ecohydrology, University of Melbourne, *Committee Hansard*, 18 May 2015, p. 33.

14 Professor Timothy Fletcher, *Committee Hansard*, 18 May 2015, p. 33.

15 Professor Tony Wong, Chief Executive Officer, CRC for Water Sensitive Cities, *Committee Hansard*, 18 May 2015, p. 24.

> for a range of pollution going in there but also the wrong quality of water at the wrong time of year.[16]

2.17 The Waterway Ecosystem Research Group referred to various published research to submit that:

- the ecological consequence of urban stormwater runoff 'is severe', with 'major loss of ecological values…observed if only a very small proportion of a catchment is developed and drained conventionally'; and
- the ecological health of streams that flow from urban catchments is generally much worse than degraded rural streams, with urban streams having 'greatly reduced biodiversity and failing to provide ecosystem services that could be provided by healthy streams (e.g. retention and treatment of pollutants; safe water bodies for primary contact; urban amenity)'.[17]

2.18 Submitters contrasted the acceptance of untreated stormwater entering urban waterways to the management of wastewater. Professor Fletcher remarked:

> …for waste water we do not consider it acceptable to just discharge it into waterways, because it poses a risk to the environment and to human health. Stormwater is exactly the same. In fact, in many of our cities it is a bigger threat to both the environment and human health, yet we still allow that to be discharged.[18]

2.19 It is not, however, the simple presence of stormwater that explains urban waterway degradation. The quantity of stormwater that enters the waterways must also be considered. Mr Andrew Allan, the National President of Stormwater Australia, discussed how the increase in impervious surfaces as a result of urban development has changed the volumes of water that waterways have to deal with during a storm event. He provided the following explanation:

> Broadly, if a stream in the past received 30 days of direct run-off and overland flow, the soil was saturated and reached capacity, and it flowed overland. That is historically or naturally. Now we might be getting up to 260 or 270 rainfall days every year where the streams are getting pummelled. So if it takes a few days for a plant to establish, flourish, lay down its roots and everything, and it is getting pummelled with water all the time, then that balance can never be there.[19]

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16 Mr Andrew Allan, National President, Stormwater Australia, *Committee Hansard*, 18 May 2015, p. 8.

17 Waterway Ecosystem Research Group, The University of Melbourne, *Submission 17*, p. 2.

18 Professor Timothy Fletcher, *Committee Hansard*, 18 May 2015, p. 34.

19 Mr Andrew Allan, Stormwater Australia, *Committee Hansard*, 18 May 2015, p. 11.

2.20 As Professor Fletcher remarked: 'The thing about stormwater is there is actually far too much of it. That is a primary driver of the degradation of streams—there is too much of it'.[20] Professor Fletcher used the Yarra River in Melbourne to illustrate the effect that runoff from urbanisation has had on the environment:

> Before the city existed, and it was forest, around 90 per cent of the rainfall that fell on the catchment in a year would have actually been evapotranspired back up into the atmosphere by trees and only about 10 per cent would make its way through the soils and eventually get into the river. When we urbanise, we completely tip that on its head. So now, rather than 10 per cent making it to the river, 90 per cent makes it to the river—almost all by washing over surfaces, of course taking with it a whole lot of pollutants and causing erosion in the river.[21]

2.21 Despite the negative environmental implications of stormwater, it was observed that stormwater is unique among sources of water with respect to how the environmental outcomes can be addressed. As Professor Ana Deletic, Deputy Chair of the Australian Academy of Technological Sciences and Engineering's Water Forum, observed:

> Stormwater is maybe the only source of water which, if it is taken out of our rivers or prevented from going into our rivers, will help our rivers, which is totally the opposite, as you know, in rural settings.[22]

Stormwater infrastructure and common management techniques

2.22 The volume of stormwater generated has implications for the management techniques used, which in turn influences the environmental consequences that arise from stormwater. This section explores this relationship by outlining the traditional approach to stormwater management and the evidence received about the stormwater infrastructure in Australia's cities.

Current infrastructure

2.23 Various submitters explained that urban stormwater management has historically focused on mitigating property damage and risk to life, with the aim being 'to transport the stormwater as rapidly as possible from our urban areas to the nearest waterways'.[23] The infrastructure in place in Australian cities for stormwater reflects this: up to 90 per cent of rainfall ends up in 'hard drainage systems' that transport stormwater to receiving waterways without treatment.[24]

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20 Professor Timothy Fletcher, *Committee Hansard*, 18 May 2015, p. 33.

21 Professor Timothy Fletcher, *Committee Hansard*, 18 May 2015, p. 33.

22 Professor Ana Deletic, Deputy Chair, Water Forum, Australian Academy of Technological Sciences and Engineering (ATSE), *Committee Hansard*, 18 May 2015, p. 18.

23 eWater, *Submission 9*, p. 2. See also Stormwater Australia, *Submission 19*, p. 5.

24 eWater, *Submission 9*, p. 2.

2.24 The majority of stormwater assets in Australian cities are made of concrete and generally require replacement every 100 to 150 years.[25] The asset base 'is believed to be in the order of tens of billions of dollars across major urban centres'.[26]

2.25 Given the expected lifetime of stormwater infrastructure, examples of ageing urban infrastructure are apparent. The committee was provided with several case studies. The City of Melbourne, for example, advised that the majority of its drainage infrastructure is over 60 years old, although some drains date back to the 1850s.[27] This infrastructure was built when flood mapping 'was poorly charted and understood', which has implications for effective stormwater management. The City noted that 'much of the existing drain infrastructure is reportedly designed to accommodate one-in-five year events and many road locations are not designed to adequately accommodate overland flow'. Work is underway on some areas of flash flooding risk so that the infrastructure is upgraded to 'cater for one-in-twenty year rainfall events'.[28]

2.26 The committee was also informed by Stormwater South Australia that 'much of the existing trunk urban stormwater drainage infrastructure in Adelaide was constructed during the 1940s to 1980s'. Stormwater South Australia outlined some of the consequences of this:

> The engineering design of these systems was based on an assumed percentage of impervious area derived from the future expected degree of development at the time of design. Other information such as design rainfalls and a catchments response to rainfall improved over time such that the stormwater design gradually became established on a much more robust technical foundation.[29]

2.27 Stormwater South Australia added, however, that since the 1980s, the construction of trunk stormwater drainage systems in Adelaide has 'slowed considerably'. Yet the city has 'seen a push towards more intensive urbanisation resulting in increased stormwater flows and urban flooding'.[30] Stormwater South Australia noted that the increased stormwater flows and urban flooding is especially evident in the parts of Adelaide where the stormwater systems 'were never upgraded to a more appropriate standard by the 1980s', although more intensive urban

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25 Australian Water Association, *Submission 47,* p. 4.

26 Stormwater Australia, *Submission 19*, p. 5.

27 City of Melbourne, *Submission 43*, p. 1.

28 City of Melbourne, *Submission 43*, p. 1.

29 Stormwater South Australia, *Submission 32*, p. 2.

30 Stormwater South Australia, *Submission 32*, p. 2.

development in the areas where the infrastructure was upgraded still presents challenges.[31]

Aquifer recharge

2.28 For geological reasons, stormwater management requirements and the possible techniques that can be utilised differ. In some areas, managed aquifer recharge for storage can be an alternative to other storage options. For example, the Stormwater Industry Association WA explained that, in the south-west region of Western Australia, rainwater 'has the potential to recharge the superficial aquifer, either prior to runoff commencing or throughout the runoff's journey in the catchment'.[32] As Mr Adam Lovell, Executive Director, Water Services Association of Australia, explained:

> …[Perth] has such shallow aquifers that stormwater is not stormwater. Basically what happens is: it rains, the water table rises, and they need to drain that groundwater which has risen.[33]

2.29 Managed aquifer recharge is also a 'common, cost effective solution for Adelaide'.[34]

2.30 These differences can present unique challenges. Dr Robin Allison from Stormwater South Australia observed that when stormwater enters the groundwater, the pollution from the stormwater causes groundwater nutrient problems. Stormwater discharged into other bodies of water, however, also causes damage. In Adelaide, for example, stormwater runoff eventually enters Gulf St Vincent, where it kills seagrass. Nevertheless, Dr Allison emphasised that the challenges presented by stormwater pollution are broadly similar. Dr Allison explained:

> The common thing is the stormwater hitting a hard surface, picking up pollutants and discharging somewhere. So I think the commonality is bigger than the differences.[35]

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31 Stormwater South Australia, *Submission 32*, p. 2. Regarding the increased urban development in areas where the trunk stormwater system had been upgraded, Stormwater South Australia noted 'the push towards more intensive urban development results in the assumed percentage of impervious area (the base assumption on which the design of the system is based) becoming outmoded'.

32 Stormwater Industry Association WA, *Submission 21*, p. 2.

33 Mr Adam Lovell, Executive Director, Water Services Association of Australia (WSAA), *Proof Committee Hansard*, 26 August 2015, p. 4.

34 Water Sensitive SA, *Submission 35*, p. 3.

35 Dr Robin Allison, Committee Member, Stormwater South Australia, *Proof Committee Hansard*, 26 August 2015, p. 34.

Stormwater as an under-utilised resource

2.31 This chapter has outlined the quantity of stormwater that is generated in Australia's cities, the environmental implications of that stormwater, and the current infrastructure in place for discharging stormwater. The general thrust of the evidence taken by the committee is that stormwater fundamentally differs from other environmental problems. That is, although stormwater is a significant environmental problem, increasing the use of stormwater could benefit the environment and provide other economic and social benefits as well. For example, Professor Timothy Fletcher stated:

> Stormwater is a big environmental problem. It is a threat to the liveability of our cities. But it is actually quite different to almost all environmental problems because it is one where using stormwater as a resource…can actually have a big benefit [for] the environment. It is rare for us to be in that situation, I think…
>
> We should be using that water, retaining that water in the landscape, which means we have this very big resource…that the streams actually need us to use. It is not a matter of just, 'Here's a resource we could use;' it is actually a resource that if we do not use we are going to continue to have degradation. It is a rare win-win: a win for us and a win for the environment.[36]

2.32 This section introduces the evidence which argued that stormwater is an under-utilised resource and highlighted the benefits that could be realised from its greater use.

Environmental benefits

2.33 Many submitters commented on the environmental benefits that could be realised if stormwater was utilised as a water resource to a greater extent. The Waterway Ecosystem Research Group, for example, submitted that its research suggests that healthy urban streams are possible if uncontrolled flows of urban stormwater runoff are prevented from reaching those streams.[37] The CRC for Water Sensitive Cities wrote:

> Stormwater harvesting combined with filtration, infiltration and irrigation can reduce runoff volumes for the vast majority of storm events to close to pre-development levels whilst also helping to restore baseflows, return natural soil moisture levels to urban landscapes and maintain water quality. Capturing and storing rainwater and/or stormwater for subsequent passive irrigation reduces runoff volumes and increases the amount of time that it takes for stormwater to reach stream channels, thereby reducing the peakiness of flows. Directing rainwater and/or stormwater into raingardens for passive irrigation can also support this outcome. In addition, stormwater treatment and harvesting systems can reduce stormwater pollutant loads and

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36 Professor Timothy Fletcher, *Committee Hansard*, 18 May 2015, p. 33.

37 Waterway Ecosystem Research Group, The University of Melbourne, *Submission 17*, p. 2.

> concentrations to levels appropriate for the protection of local receiving waters and downstream estuaries and bays…[38]

2.34 The interconnectivity of river systems was also noted, with an example provided of how reduced water use in Melbourne has implications for the volume of water that reaches the Murray River and Murray-Darling Basin communities:

> In terms of the Murray-Darling Basin we, potentially, in Melbourne can take water out of the Goulburn. That has an effect all the way over to Adelaide. By not turning on that system, and using the water locally, we are helping those greater basin catchments, and that covers a huge part of Australia.[39]

Costs that could be foregone

2.35 Direct and indirect costs associated with stormwater were noted, such as flooding-related costs and the need to build stormwater infrastructure, both as a result of increasing urban populations and to replace existing ageing infrastructure.

2.36 In relation to flooding, Mr Chris Beardshaw, Secretary, Stormwater Victoria, suggested that improved stormwater management may alleviate the need to expand existing infrastructure or to identify other water management solutions. He stated:

> Flooding in Australia is a lot about antecedent conditions or how wet the catchment is. In 2011, there was lots of rain and then rain on top of rain, and lots of flooding. In the urban environment we do not have that because we are concrete. We do not fill the voids to start with. So on climate change and more intensity, we cannot make all our small pipes bigger. Are there ways that we can protect ourselves from flooding without having to do other things? That is one of the real opportunities here.[40]

2.37 Stormwater Australia argued that storm flooding in urban areas is 'a significant, but poorly understood cost to society'.[41] Mr Andrew Allan, President, Stormwater Australia told the committee:

> Flooding is a significant issue, particularly in cities that have been developed pre the 1970s, before recognised standards were in place, and for many people who suffer from flooding impacts there are insurance costs and disruption to life cycle costs that are quite significant…Also, into the future, climate change is something of concern. We know the science is

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38 CRC for Water Sensitive Cities, *Submission 44*, p. 5. The CRC's submission cited the following research: T Wong, R Allen, R Brown, A Deletic, L Gangadharan, W Gernjak, C Jakob, P Jonstone, M Reeder, N Tapper, G Vietz and C Walsh, 2013, *bluprint2013 – Stormwater Management in a Water Sensitive City*, Melbourne, Australia: Cooperative Research Centre for Water Sensitive Cities, July 2013.

39 Mr Ralf Pfleiderer, President, Stormwater Victoria, *Committee Hansard*, 18 May 2015, p. 8.

40 Mr Chris Beardshaw, Stormwater Victoria, *Committee Hansard*, 18 May 2015, p. 4.

41 Stormwater Australia, *Submission 19*, p. 5.

> telling us that there is going to be less water overall and when it rains we are likely to get more intense rainfalls, which is going to exacerbate both our need to have water not only to supply for consumptive needs in the cities but also to manage the drainage and the impacts as well.[42]

2.38 One potential indicator of the cost of storm damage is insurance premiums. Stormwater Australia stated that it 'is not currently well understood how insurance companies account and charge for flood risk'; however, it suggested that insurance premiums for houses located near stormwater systems and waterways had, in recent years, increased by a greater amount than the premiums for houses located in rural areas away from stormwater systems and waterways.[43]

2.39 Estimates were also provided about the expected cost associated with upgrading ageing infrastructure. Professor Ana Deletic told the committee that to maintain the same level of flood protection in Melbourne, it is estimated that $8 billion will need to be invested in the next few decades to keep up with development and to address ageing infrastructure. Professor Deletic remarked that it 'costs a fortune to…put bigger pipes in'. In her view, the implementation of green systems (which are discussed later in this chapter: see paragraph 2.54), could 'delay the accumulation of ageing infrastructure' and prevent additional stormwater from entering urban drainage systems.[44]

Potential uses for stormwater

2.40 Stormwater Australia advised that, with the exception of Perth, it is estimated that less than three per cent of rainwater and stormwater is used.[45] As this chapter has already noted, the volume of stormwater runoff is similar to, and in some cities exceeds, the amount of water that urban areas draw from their traditional water catchments (see Figure 2.1). Given this, submissions considered the possibility and benefits of utilising stormwater so that the urban areas themselves became a water catchment. It was also noted in relation to this that stormwater runoff is unique as a water resource because it 'grows with increasing urban development'.[46]

2.41 The potential for stormwater to support other water sources during periods such as drought was noted in several submissions. For example, the CRC for Water Sensitive Cities stated:

> As many Australian cities and towns experienced severe drought in recent times, we now recognise that we are entering an era where natural resources

42 Mr Andrew Allan, Stormwater Australia, *Committee Hansard*, 18 May 2015, p. 1.

43 See Stormwater Australia, *Submission 19*, p. 7.

44 Professor Ana Deletic, ATSE, *Committee Hansard*, 18 May 2015, p. 20.

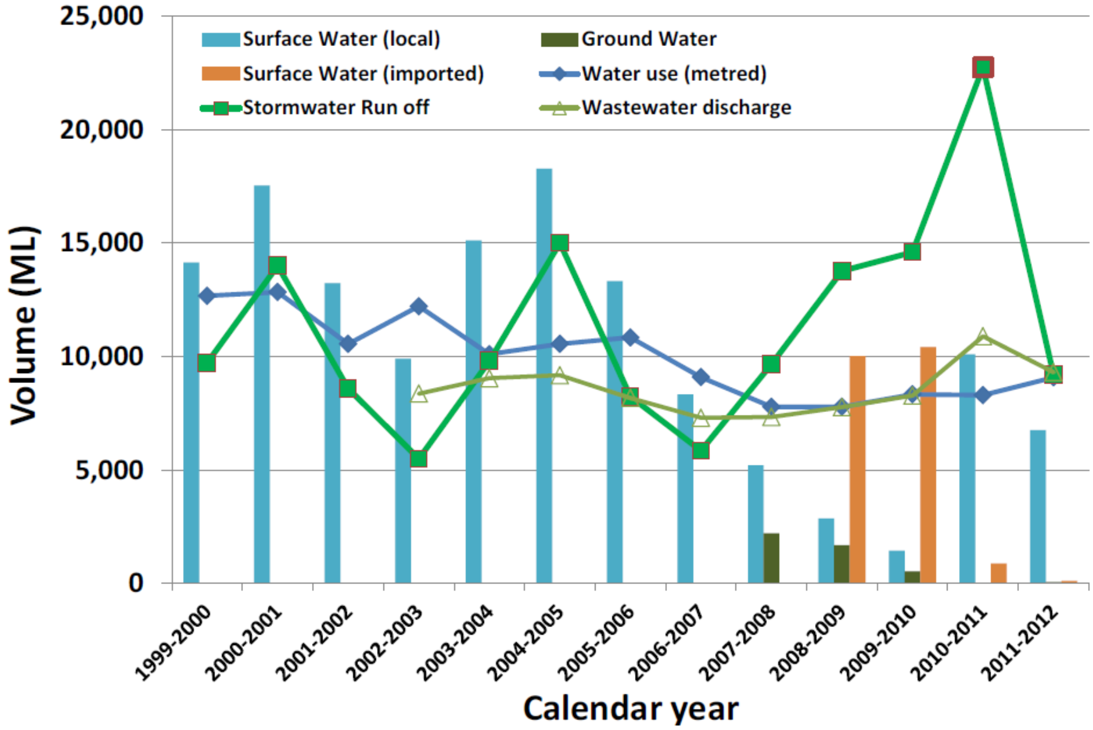
45 Stormwater Australia, *Submission 19*, p. 3. Similarly, Urban Water Cycle Solutions argued that the water from rainwater, stormwater and wastewater sources 'is not fully exploited'. Urban Water Cycle Solutions, *Submission 41*, p. 5.

46 Waterway Ecosystem Research Group, The University of Melbourne, *Submission 17*, p. 3.

are reaching their carrying capacity limits. We need to do more with what we have.[47]

2.42 The CSIRO stated that stormwater harvesting and water recycling 'could help to generate long term water storage for drought and emergency supplies in all major cities'.[48] The potential benefits of stormwater harvesting during a drought were illustrated in the submission from Urban Water Cycle Solutions. Using the city of Ballarat as an example, it was argued that substantial volumes of local stormwater runoff were available throughout the 2000s drought, however, the Ballarat region instead imported surface water from distant communities and irrigation districts (see Figure 2.3).[49]

Figure 2.3: Water cycle processes in the Ballarat Water District from 1999 to 2012



Source: Urban Water Cycle Solutions, *Submission 41*, p. 8.

2.43 Potential uses for stormwater in agriculture were also noted. The CSIRO suggested that fresh stormwater could be blended with high salinity recycled water to 'expand the current use of recycled water in irrigation and increase productivity through application to high value crops which are sensitive to the salinity of the irrigation supply'.[50]

47 CRC for Water Sensitive Cities, *Submission 44*, p. 1.

48 CSIRO, *Submission 42*, p. 3.

49 Urban Water Cycle Solutions, *Submission 41*, p. 9.

50 CSIRO, *Submission 42*, p. 3.

2.44 The key challenges associated with utilising stormwater were identified in a 2007 report of the Prime Minister's Science, Engineering and Innovation Council's working group. The report, *Water for our cities: building resilience in a climate of uncertainty*, stated that challenges to utilising stormwater include that:

- the water requires treatment to remove the pollutants that are harmful to human health;
- stormwater would need to be captured and stored during a storm 'in an urban environment where space is at a premium'; and
- the infrastructure required for water capture and treatment would, because of the intermittent nature of storm events, 'be used only intermittently, thus increasing the per unit capital cost'.[51]

2.45 The report noted that the storage of stormwater in underground aquifers is 'a possible way to both store and treat the captured water but for geological reasons this is an option only available to a few cities such as Perth and Adelaide'.[52]

Improving the liveability of cities

2.46 Submitters argued that the increased use of stormwater has the potential to improve the sustainability, resilience and liveability of cities by supporting the greening of cities.

2.47 In addition to improving the health of urban waterways by reducing the volume of stormwater that enters them, the CRC for Water Sensitive Cities argued that stormwater could support green spaces in cities. The CRC identified that increased greening of cities through the use of stormwater could result in:

- 'improved human thermal comfort', leading to reduced heat-related stress and mortality;
- 'productive vegetation and increased carbon sequestration';
- improvements in 'air quality through deposition'; and
- improved landscape amenity.[53]

51 Prime Minister's Science, Engineering and Innovation Council (PMSEIC) Working Group, *Water for our cities: building resilience in a climate of uncertainty*, June 2007, www.industry.gov.au/science/PMSEIC/Documents/WaterforOurCities.pdf (accessed 8 May 2015), p. 33.

52 These aquifers are 'porous layers of soil or rock that allow water to be stored and recovered, hence the name aquifer storage and recovery'. Under this process, passive pre-treatment is provided by a wetland or reedbed. PMSEIC Working Group, *Water for our cities*, p. 33.

53 CRC for Water Sensitive Cities, *Submission 44*, pp. 6–7.

2.48 Ms Mellissa Bradley from Water Sensitive SA indicated how the use of stormwater for green spaces in cities would support the health of those spaces and return a greater volume of water to the groundwater. Ms Bradley explained:

> The imbalance in the water cycle has become so great that we are no longer replenishing the groundwater supplies. Therefore, our green spaces are just so moisture depleted because we are really messing so much with the urban water cycle, and to sustain those green spaces we are going to have to bring more water in.[54]

2.49 Dr Robin Allison from Stormwater South Australia also observed that stormwater could support existing parks:

> Every iconic park in Australia, if not the world, has water involved in it. If you can make stormwater part of that, whether it is harvesting or treatment system, it is a huge benefit to the community.[55]

2.50 How parks and green spaces can improve liveability in cities by mitigating heat was addressed during the committee's hearings. Mr Andrew King, Chair, Stormwater South Australia, explained how urban heat is distributed in Adelaide:

> …on an early March morning at break of dawn, the temperature over Adelaide's city centre was 10 degrees warmer than it was over the Parklands. That is because of the hard surface, the heat sink and everything else like that. That relates back to a suburban environment. If you have all house and hard space—all impervious area—in an urban environment, that one park at the end of every three or four streets, no matter how well it is manicured or preserved, is not going to provide that cooling effect. It needs to be done street by street. So they provide amenity; they provide greenery.[56]

2.51 Professor Ana Deletic outlined the microclimatic benefits that systems such as wetlands and rain gardens can provide for cities. Professor Deletic noted that 'having trees or greenery is good for our cities; it not only reduces temperature but provides human comfort'.[57] Related to this, the effect that urban heat can have on hospital costs was also highlighted. Mr Andrew King explained:

> Hospitals have a key temperature in the high thirties where they put on extra staff, and the cost to the health service every year of that cut-off point is hundreds of millions of dollars. They budget that they are going to get five or six of those days a year. That is budgeted in. If we raise our city temperatures by 10 degrees and those five or six days become 12, even

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54 Ms Mellissa Bradley, Program Manager, Water Sensitive SA, *Proof Committee Hansard*, 26 August 2015, p. 26.

55 Dr Robin Allison, Stormwater South Australia, *Proof Committee Hansard,* 26 August 2015, p. 30.

56 Mr Andrew King, Chair, Stormwater South Australia, *Proof Committee Hansard*, 26 August 2015, p. 30.

57 Professor Ana Deletic, ATSE, *Committee Hansard*, 18 May 2015, p. 19.

> doubling it, you have hundreds of millions. That one cost alone blows out any water-saving cost that you would ever put to green infrastructure in a city environment.[58]

2.52 Mr Ralf Pfleiderer, representing the City of Melbourne, highlighted the City's Urban Forest Strategy. The Strategy supports healthy trees that 'provide greater canopy', helping to shade streets and mitigate summer heat. Mr Pfleiderer noted that water for soil moisture 'is a key part of keeping those trees healthy'. He added:

> Stormwater, either from irrigation or passive infiltration, is something we are promoting quite strongly and are trying to put in place wherever we can. It is a slow process in terms of cost and finding the space for it.[59]

2.53 The committee also received specific examples of how addressing water quality issues could improve the liveability of cities. For example, Mr Andrew King, Chair, Stormwater South Australia, noted that addressing water quality can limit blue-green algae growth and the odour that this brings. He used Torrens Lake in Adelaide as an example:

> One of the things that Adelaide is somewhat iconic for, for the wrong reasons, is its Torrens Lake. Every time we try to run a major event in the middle of the city in summer, we inevitably end up with a blue-green algae bloom which adds a wonderful odour to Adelaide. The key thing producing that algae bloom is the nutrient pollutant in stormwater run-off.[60]

2.54 New types of projects that use stormwater to improve liveability were also noted. The committee received evidence on 'green infrastructure', which the CRC for Water Sensitive Cities argued 'provides benefits by creating more liveable and resilient urban environments'.[61] In an article on green infrastructure that was provided to the committee, Professor Ana Deletic wrote that raingardens, green roofs, green walls and living walls, collectively called biofiltration, are 'affordable, attractive solutions'. Professor Deletic explained how biofilters are beneficial:

> They act as natural filters—carefully selected soils and plants trap and clean water as it sinks through roots. At the same time they green and cool our cities. Because they are made from natural materials and are often gravity-fed, their costs are minimal.[62]

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58 Mr Andrew King, Stormwater South Australia, *Proof Committee Hansard*, 26 August 2015, p. 31.

59 Mr Ralf Pfleiderer, Water Sensitive Urban Design Coordinator, City of Melbourne, *Committee Hansard*, 18 May 2015, p. 14.

60 Mr Andrew King, Stormwater South Australia, *Proof Committee Hansard*, 26 August 2015, pp. 30–31.

61 CRC for Water Sensitive Cities, *Submission 44*, p. 8.

62 A Deletic, 'Integrated water management can boost "liveability" in cities', *ATSE Focus*, no. 181, December 2013, p. 3; *Additional Information 12*, p. 1.

2.55 In the article, Professor Deletic outlined research undertaken by the Monash Water for Liveability Centre and the CRC for Water Sensitive Cities that aims 'to develop low-energy, affordable biofilters for both stormwater harvesting and wastewater recycling'. Professor Deletic wrote:

> …we are currently developing living walls that can treat light greywatcr (from wash basins, baths or showers) for safe irrigation and, with minimal additional treatment, for non-potable uses such as toilet flushing.
>
> Imagine a wall of plants—a vertical canopy—comprising two to three storeys, each with species chosen for their talents as organic filters. Deciduous climbing plants on upper storeys allow for sunlight to be screened in summer for cooling (wall-climbing vines can significantly reduce temperatures of buildings and adjacent areas) and captured in winter for heating.
>
> On lower storeys, evergreen sedges and flowering plants enable greywater treatment in winter months. Living walls thus address both water supply and urban heat wave problems—a living wall for greywater recycling installed at a typical residential apartment could save more than 20 per cent of the potable water needs of its residents, while reducing temperature of the building surface by more than 10°C.[63]

2.56 When considering green infrastructure, another relevant matter is the evidence that indicates it has a positive effect on property values. Professor Ana Deletic explained:

> A very recent study, which we cited in our submission, talks about how there is now evidence that the value of properties near these systems is increased substantially. Our colleagues who work with us within the CRC for Water Sensitive Cities looked into the prices of over 4,000 houses in Sydney and linked them to where they are placed. They found that, if your house is overlooking a rain garden 50 metres from one of these stormwater measurement systems, the price goes up six per cent, which is roughly $54,000. The value of such a garden is only $15,000 or $20,000. So, on the pure amenity value, we see a huge return.[64]

2.57 The CRC for Water Sensitive Cities provided further research that supported the argument that property price values increase with proximity to natural systems and when water sensitive urban design infrastructure, including rainwater tanks, raingardens and stream restoration, is present. The CRC for Water Sensitive Cities used research that considered Perth property prices as an example:

> A hedonic house price analysis in Perth suggests there is a premium of up to AU$18,000 built into the sale prices of houses with tanks installed. The premium is likely to be greater than the costs of installation, even allowing for the cost of time that home owners must devote to research,

63 A Deletic, 'Integrated water management can boost "liveability" in cities', p. 3; *Additional Information 12*, p. 1.

64 Professor Ana Deletic, ATSE, *Committee Hansard*, 18 May 2015, p. 19.

> purchase and installation. The policy implication is that government need not rely on financial incentives for installation of rainwater tanks, but instead use information provision as their main mechanism for promoting uptake…[65]

2.58 Finally, it was suggested that a greater emphasis on more liveable public open spaces will inevitably occur as a result of growing urban populations. Professor Tony Wong explained:

> …there are many other benefits in innovative management of urban stormwater, beyond the droughts, the floods and the improvement of water quality. Those multiple benefits would include issues of creating higher biodiversity in our urban environment, creating significant opportunity for mitigating urban heat and introducing microclimate environments, and opportunity for urban stormwater to be a central feature in how we deliver green spaces in our cities. That is connected very much to the fact that our urban environments have a growing population and that the shift in emphasis from the amenity of a private open space to a public open space will occur. As you see this shift, you will see that the public realm and public open space will become more and more important to the liveability of our space.[66]

Conclusion

2.59 Australia's cities generate enormous volumes of stormwater. Not only does this stormwater cause significant environmental damage, it is a resource that is clearly not utilised to its full potential.

2.60 This chapter has highlighted many of the interesting opportunities that exist to utilise stormwater to a greater extent. Increased utilisation of stormwater will deliver various environmental benefits, however, it is apparent that other economic and social benefits are also possible. This chapter has demonstrated the attention that experts in this field have given to these possibilities. The remaining chapters of the report examine the efforts to date, and the challenges and impediments that may affect the speed and rate at which stormwater projects are developed.

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65 CRC for Water Sensitive Cities, *Submission 44*, p. 9. The research cited was: F Zhang, M Polyakov, J Fogarty and D J Pannell, 2015, 'The capitalized value of rainwater tanks in the property market of Perth, Australia', *Journal of Hydrology*, 522, 317–325.

66 Professor Tony Wong, CRC for Water Sensitive Cities, *Committee Hansard*, 18 May 2015, p. 24.